December 10, 1885.

Professor G. G. STOKES, D.C.L., President, in the Chair.

The Presents received were laid on the table and thanks ordered for them.

The President announced that he had appointed as Vice-Presidents—

The Treasurer.
Dr. Archibald Geikie.
Sir Joseph Hooker.
Professor Huxley.
General Strachey.

Dr. John Anderson (elected 1879) was admitted into the Society.

Pursuant to notice, Professors Adolf Baeyer, Felix Klein, A. Kowalewski, and Sven Lovén were balloted for and elected Foreign Members of the Society.

The following Papers were read:—

I. "Preliminary Results of a Comparison of certain simultaneous Fluctuations of the Declination at Kew and at Stonyhurst during the Years 1883 and 1884, as recorded by the Magnetographs at these Observatories." By the Rev. STEPHEN JOSEPH PERRY, F.R.S., Director of the Stonyhurst Observatory, and BALFOUR STEWART, LL.D., F.R.S., Professor of Physics at the Owens College, Manchester. Received October 31, 1885.

From a comparison made by Messrs. Sidgreaves and Stewart ("Proc. Roy. Soc.," October, 1868), between a few prominent simultaneous changes of declination at Kew and at Stonyhurst, it appeared that the ratio between the magnitudes of such changes was not constant, but depended to some extent upon the abruptness of the disturbance.

With the view of examining into this matter, we have made a somewhat more detailed comparison, selecting for this purpose some

of the best marked fluctuations during the years 1883 and 1884, both large and small, abrupt and non-abrupt.

There are two ways in which such a comparison may be made, the first of these being to measure the vertical difference in the declination curve between the two turning points of a fluctuation. This is the method which we have pursued in this investigation. It is, however, subject to the objection that the course of the curve between two such poiuts is not precisely a straight line, and hence that this course embraces different values of abruptness.

On the whole, however, this method as we have used it appears to us to lead to definite, and we think not inaccurate, results. The other method would be to compare together the simultaneous rates of change of the declination at the two observatories, selecting for this purpose such portions of the records as present the appearance of constant slope, that is to say are straight lines.

This method we have not hitherto pursued, but it is possible that we may do so, and compare it with the other in a contemplated future research.

It is unnecessary to give a description of the magnetographs at the two observatories, suffice it to say that both declination magnets are as nearly as possible of the same size and weight, being about 5·5 inches long, 0·8 inch broad, and 0·1 inch thick.

The scale of the arrangement is, however, different at the two observatories in such a manner that at Kew 1 mm. of scale = 0·87′, while at Stonyhurst 1 mm. of scale = 1·13′. It would thus appear that equal vertical curve-differences at Kew and at Stonyhurst are to each other very nearly in the proportion of 1 to 1·3. This is the proportion which we shall use in the present paper.

For the Kew results, we are indebted to the kindness of the Kew Committee; of Mr. Whipple, Superintendent of the Kew Observatory; and of Mr. Baker, the magnetical assistant there.

In the following table (I) we have embodied the actual results of the various measurements:—

Table I.—Results of the various Experiments.

Running number.	Date.	Time of commencement.		Time of end.		Nature of change of westerly declination.	Amount of vertical change in curve-inches.	
		K.	S.	K.	S.		K.	S.
	1883.	h. m.	h. m.	h. m.	h. m.			
1	February 22	6 5 P.M.	6 5 P.M.	6 22 P.M.	6 21 P.M.	Decrease	1·50	1·60
2	,,	6 22 ,,	6 21 ,,	6 35 ,,	6 35 ,,	Increase	1·13	1·48
3	,,	6 35 ,,	6 35 ,,	6 44 ,,	6 42 ,,	Decrease	0·15	0·44
4	,,	6 44 ,,	6 42 ,,	6 58 ,,	6 56 ,,	Increase	0·30	0·38
5	,, 25	1 5 A.M.	1 5 A.M.	1 57 A.M.	1 55 A.M.	,,	1·34	1·33
6	,,	1 57 ,,	1 55 ,,	2 13 ,,	2 11 ,,	Decrease	0·38	0·45
7	,,	2 13 ,,	2 11 ,,	2 19 ,,	2 17 ,,	Increase	0·20	0·18
8	,,	2 19 ,,	2 17 ,,	2 40 ,,	2 39 ,,	Decrease	0·93	0·97
9	,,	2 40 ,,	2 39 ,,	2 52 ,,	2 49 ,,	Increase	1·06	1·34
10	,,	2 52 ,,	2 49 ,,	2 53 ,,	2 52 ,,	Decrease	0·04	0 06
11	,,	2 53 ,,	2 52 ,,	2 55 ,,	2 54 ,,	Increase	0·17	0·14
12	,,	2 55 ,,	2 54 ,,	2 56 ,,	2 56 ,,	Decrease	0·05	0·11
13	,,	2 56 ,,	2 56 ,,	3 1 ,,	2 59 ,,	Increase	0·42	0·31
14	,,	3 1 ,,	2 59 ,,	3 42 ,,	3 39 ,,	Decrease	1·67	1·56
15	July 14	2 10 P.M.	2 10 P.M.	2 15 P.M.	2 13 P.M.	Increase	0·08	0·13
16	,,	2 15 ,,	2 13 ,,	2 25 ,,	2 22 ,,	Decrease	0·04	0·17
17	,,	2 25 ,,	2 22 ,,	2 35 ,,	2 34 ,,	Increase	0·06	0·06
18	,,	2 35 ,,	2 34 ,,	2 45 ,,	2 42 ,,	Decrease	0·08	0·06
19	,,	2 45 ,,	2 42 ,,	2 50 ,,	2 46 ,,	Increase	0·08	0·09
20	,,	2 50 ,,	2 46 ,,	3 00 ,,	2 57 ,,	Decrease	0·27	0·25
21	,,	3 00 ,,	2 57 ,,	3 3 ,,	3 00 ,,	Increase	0·04	0·10
22	,,	3 3 ,,	3 00 ,,	3 21 ,,	3 19 ,,	Decrease	0·66	0·69
23	,,	3 21 ,,	3 19 ,,	3 34 ,,	3 31 ,,	Increase	0·33	0·41
24	August 18	10 5 ,,	10 5 ,,	10 33 ,,	10 34 ,,	,,	0·84	0·81
25	,,	10 33 ,,	10 34 ,,	11 0 ,,	11 0 ,,	Decrease	0·81	0·90

Running number.	Date.	Time of commencement.		Time of end.		Nature of change of westerly declination.	Amount of vertical change in curve-inches.	
		K.	S.	K.	S.		K.	S.
	1883.	h. m.	h. m.	h. m.	h. m.			
26	August 18	11 0 P.M.	11 0 P.M.	11 5 P.M.	11 4 P.M.	Decrease	0·07	0·07
27	„	11 5 „	11 4 „	11 40 „	11 40 „	Increase	0·23	0·34
28	October 15	9 40 „	9 40 „	9 43 „	9 44 „	„	0·07	0·07
29	„	9 43 „	9 44 „	10 10 „	10 11 „	Decrease	0·49	0·51
30	„	10 10 „	10 11 „	10 26 „	10 27 „	Increase	0·49	0·53
31	„	10 26 „	10 27 „	10 49 „	10 49 „	Decrease	0·33	0·36
32	„ 17	3 3 A.M.	3 3 A.M.	3 5 A.M.	3 7 A.M.	Increase	0·02	0·02
33	„	3 5 „	3 7 „	3 15 „	3 15 „	Decrease	0·10	0·13
34	„	3 15 „	3 15 „	3 17 „	3 18 „	Increase	0·05	0·07
35	„	3 17 „	3 18 „	3 30 „	3 30 „	Decrease	0·19	0·18
36	„	3 30 „	3 30 „	3 40 „	3 40 „	Increase	0·29	0·28
37	„	3 40 „	3 30 „	3 49 „	3 48 „	„	0·13	0·09
38	„	3 49 „	3 48 „	4 40 „	4 39 „	Decrease	0·42	0·69
39	„	4 40 „	4 39 „	4 53 „	4 52 „	„	0·43	0·44
40	„	4 53 „	4 52 „	5 17 „	5 15 „	Increase	0·91	1·02
41	„	5 17 „	5 15 „	5 45 „	5 44 „	„	0·27	0·26
42	„ 19	7 35 P.M.	7 33 P.M.	7 39 P.M.	7 38 P.M.	„	0·06	0·10
43	„	7 39 „	7 38 „	7 55 „	7 55 „	Decrease	0·27	0·32
44	„	7 55 „	7 55 „	8 20 „	8 19 „	Increase	0·39	0·47
45	„	8 20 „	8 19 „	8 37 „	8 37 „	Decrease	0·16	0·23
46	„	8 37 „	8 37 „	9 3 „	9 2 „	Increase	0·26	0·33
47	„ 20	6 13 „	6 14 „	6 25 „	6 27 „	Decrease	0·11	0·10
48	„	6 25 „	6 27 „	6 34 „	6 35 „	Increase	0·13	0·10
49	„	6 34 „	6 35 „	7 0 „	7 2 „	Decrease	0·54	0·46
50	„	7 0 „	7 2 „	7 6 „	7 7 „	„	0·17	0·19
51	„	7 6 „	7 7 „	7 37 „	7 38 „	Increase	0·61	0·67
52	„	7 37 „	7 38 „	7 50 „	7 50 „	Decrease	0·67	0·71
53	„	7 50 „	7 50 „	8 10 „	8 12 „	Increase	0·54	0·59

Running number.	Date.	Time of commencement.		Time of end.		Nature of change of westerly declination.	Amount of vertical change in curve-inches.	
		K.	S.	K.	S.		K.	S.
	1883.	h. m.	h. m.	h. m.	h. m.			
54	October 20	8 10 P.M.	8 12 P.M.	8 14 P.M.	8 15 P.M.	Decrease	0·05	0·07
55	„	8 14 „	8 15 „	8 20 „	8 20 „	Increase	0·03	0·03
56	„	8 20 „	8 20 „	8 29 „	8 31 „	Decrease	0·40	0·41
57	November 2	4 50 „	4 49 „	5 3 „	5 3 „	Increase	0·37	0·43
58	„	5 3 „	5 3 „	5 18 „	5 18 „	Decrease	0·60	0·63
59	„	5 18 „	5 18 „	5 35 „	5 36 „	Increase	0·27	0·31
60	„	5 35 „	5 36 „	5 40 „	5 42 „	Decrease	0·03	0·04
61	„	5 40 „	5 42 „	5 55 „	5 56 „	Increase	0·15	0·14
62	„ 22	1 13 „	1 13 „	1 20 „	1 20 „	Decrease	0·11	0·17
63	„	1 20 „	1 20 „	1 40 „	1 39 „	Increase	0·12	0·19
64	„	1 40 „	1 39 „	1 49 „	1 50 „	Decrease	0·17	0·22
65	„	1 49 „	1 50 „	1 58 „	1 56 „	Increase	0·57	0·46
66	„	1 58 „	1 56 „	2 9 „	2 9 „	Decrease	0·67	0·55
67	„	2 9 „	2 9 „	2 18 „	2 19 „	Increase	0·30	0·35
68	„	2 18 „	2 19 „	2 22 „	2 24 „	Decrease	0·15	0·23
69	„	2 22 „	2 24 „	2 25 „	2 27 „	Increase	0·03	0·07
70	„	2 25 „	2 27 „	2 32 „	2 35 „	Decrease	0·09	0·10
71	„	2 32 „	2 35 „	2 42 „	2 42 „	Increase	0·18	0·22
72	„	2 42 „	2 42 „	2 50 „	2 49 „	Decrease	0·14	0·15
73	„	5 8 „	5 7 „	5 22 „	5 22 „	„	0·20	0·25
74	„	5 22 „	5 22 „	6 9 „	6 8 „	„	0·56	0·53
75	„	6 9 „	6 8 „	6 35 „	6 32 „	Increase	0·57	0·60
76	„	6 35 „	6 32 „	6 55 „	6 55 „	Decrease	0·09	0·17
77	„	6 55 „	6 55 „	7 13 „	7 13 „	Increase	0·32	0·51
78	„	7 13 „	7 13 „	7 20 „	7 19 „	Decrease	0·16	0·34
79	„	9 18 „	9 18 „	9 35 „	9 34 „	Increase	0·24	0·27
80	„	9 35 „	9 34 „	9 57 „	9 55 „	„	0·18	0·22
81	„	11 0 „	10 58 „	11 20 „	11 18 „	Decrease	0·44	0·45

Running number.	Date.	Time of commencement. K.	Time of commencement. S.	Time of end. K.	Time of end. S.	Nature of change of westerly declination.	Amount of vertical change in curve-inches. K.	Amount of vertical change in curve-inches. S.
	1883.	h. m.	h. m.	h. m.	h. m.			
82	November 23	0 7 A.M.	0 6 A.M.	0 20 A.M.	0 19 A.M.	Decrease	0·52	0·60
83	"	0 20 "	0 19 "	0 30 "	0 28 "	Increase	0·44	0·61
84	"	0 30 "	0 28 "	0 43 "	0 43 "	Decrease	0·31	0·42
85	"	0 43 "	0 43 "	0 49 "	0 49 "	Increase	0·14	0·25
86	"	0 49 "	0 49 "	0 54 "	0 53 "	Decrease	0·09	0·17
87	"	0 54 "	0 53 "	1 2 "	1 0 "	Increase	0·15	0·21
88	"	1 2 "	1 0 "	1 13 "	1 15 "	Decrease	0·28	0·34
89	"	1 13 "	1 15 "	1 28 "	1 28 "	Increase	0·41	0·43
90	"	4 13 "	4 12 "	4 35 "	4 34 "	Decrease	0·33	0·29
91	"	4 35 "	4 34 "	5 42 "	5 41 "	Increase	0·78	0·75
92	"	11 3 P.M.	11 4 P.M.	11 30 P.M.	11 30 P.M.	Decrease	0·51	0·51
93	December 17	8 15 "	8 16 "	8 56 "	8 57 "	"	0·97	0·95
94	"	8 56 "	8 57 "	9 2 "	9 3 "	Increase	0·08	0·08
95	"	9 2 "	9 3 "	9 10 "	9 13 "	Decrease	0·11	0·13
96	"	9 10 "	9 13 "	9 35 "	9 35 "	Increase	0·53	0·57
97	" 18	6 50 "	6 48 "	7 15 "	7 13 "	Decrease	0·25	0·27
98	"	7 15 "	7 13 "	7 34 "	7 32 "	Increase	0·31	0·38
99	" 25	4 10 "	4 10 "	4 15 "	4 15 "	"	0·01	0·02
100	"	4 15 "	4 15 "	4 20 "	4 20 "	Decrease	0·02	0·04
101	"	4 20 "	4 20 "	4 48 "	4 48 "	"	0·51	0·48
102	"	4 48 "	4 48 "	5 0 "	5 0 "	Increase	0·23	0·24
103	"	5 0 "	5 0 "	5 30 "	5 30 "	"	0·12	0·13
	1884.							
104	February 29	9 32 "	9 33 "	10 8 "	10 7 "	Decrease	0·97	0·95
105	July 3	9 20 "	9 18 "	9 31 "	9 30 "	"	1·11	1·18
106	"	9 31 "	9 30 "	9 40 "	9 39 "	Increase	0·70	0·99
107	"	9 40 "	9 39 "	9 44 "	9 44 "	Decrease	0·09	0·42
108	"	9 44 "	9 44 "	9 57 "	9 56 "	Increase	1·06	1·33

Running number.	Date.	Time of commencement.		Time of end.		Nature of change of westerly declination.	Amount of vertical change in curve-inches.	
		K.	S.	K.	S.		K.	S.
	1884.	h. m.	h. m.	h. m.	h. m.			
109	July 3	9 57 P.M.	9 56 P.M.	10 7 P.M.	10 5 P.M.	Decrease	1·03	1·37
110	„	10 7 „	10 5 „	10 15 „	10 13 „	Increase	0·49	0·86
111	„	10 15 „	10 13 „	10 21 „	10 20 „	Decrease	0·18	0·48
112	„	10 21 „	10 20 „	10 31 „	10 29 „	Increase	0·57	0·73
113	„	10 31 „	10 29 „	10 41 „	10 40 „	Decrease	0·48	0·61
114	„	0 38 A.M.	0 38 A.M.	1 15 A.M.	1 15 A.M.	Increase	1·32	1·30
115	September 17–18 ..	11 48 P.M.	11 46 P.M.	0 13 „	0 10 „	Decrease	0·78	0·98
116	October 3	2 50 A.M.	2 49 A.M.	4 3 „	4 2 „	Increase	0·86	0·85
117	November 2	7 1 P.M.	7 4 P.M.	7 13 P.M.	7 15 P.M.	Decrease	0·96	1·07
118	„	7 13 „	7 15 „	7 19 „	7 21 „	Increase	0·80	0·99
119	„ 3	1 39 A.M.	1 40 A.M.	2 13 A.M.	2 14 A.M.	„	1·51	1·43
120	December 14	8 32 P.M.	8 34 P.M.	9 36 P.M.	9 37 P.M.	Decrease	0·99	0·94
121	„	9 36 „	9 37 „	10 20 „	10 20 „	Increase	0·79	0·77
122	„ 22	10 13 „	10 13 „	10 37 „	10 39 „	„	0·94	1·02
123	„	10 37 „	10 39 „	11 10 „	11 11 „	Decrease	1·06	1·14

We do not know of a single instance in which the fluctuation is not in the same direction at both observatories.

We have given the G.M.T. of the commencement and end of each fluctuation at each observatory. Practically speaking, the times at both places are so nearly simultaneous that we do not feel justified in asserting that they are not quite so. Occasionally, however, there are indications that certain short period fluctuations are not precisely of the same duration at both places. In what follows we have rejected such cases; also we have adopted the durations as recorded at the Kew Observatory, rejecting however all cases when these are less than five minutes, inasmuch as an accurate measure of duration is essential to our method.

Let us now, simply as a conjecture which may be of service in indicating the best method of treating the observations of Table I, suppose that in these disturbances two causes are in operation, and that the result is due partly to true magnetic changes, and in part to secondary currents caused by these changes.

Let K denote the whole observed value of the disturbance at Kew, and of this let k denote the portion due to strictly magnetic change, also let $\alpha k\phi(t)$ be the portion of the whole disturbance caused by secondary action, α being a constant which may conceivably be either positive or negative, and t denoting the duration. Hence $K = k(1+\alpha\phi(t))$. In like manner let S denote the whole Stonyhurst change.

We are, perhaps, justified in putting $S = k(\beta + \gamma\phi(t))$, β and γ being constants.

Hence we shall have $\frac{S}{K}=\frac{\beta+\gamma\phi(t)}{1+\alpha\phi(t)}$, that is to say, $\frac{S}{K}$ will be a function of the duration.

It thus appears that the value of $\frac{S}{K}$ will, according to this or indeed according to any probable hypothesis of this nature, be independent of the values of S and K, and be a simple function of the duration.

These reasons have induced us to construct the following table (II), in which the ratio $\frac{S}{K}$ is ascertained for disturbances of varying durations.

Table II.—Value of $\frac{S}{K}$ for Disturbances of different Duration.

Duration in minutes	5. K.	5. S.	6. K.	6. S.	7. K.	7. S.	8. K.	8. S.	9. K.	9. S.	10. K.	10. S.	11. K.	11. S.	12. K.	12. S.	13. K.	13. S.	14. K.	14. S.
	42	31	20	18	11	17	14	15	—		4	17	111	118	11	10	113	148	30	38
	8	9	17	19	9	10	15	21	13	9	27	25	—		23	24	33	41	20	25
	7	7	3	3	16	34	49	86	13	10	29	28	—		96	107	19	18	—	
	3	4	14	25	—		—		30	35	44	61	—		—		43	44	—	
	9	17	8	8	—		—		70	99	103	137	—		—		67	71	—	
	1	2	18	48	—		—		—		57	73	—		—		37	43	—	
	2	4	80	99	—		—		—		48	61	—		—		52	60	—	
	—		—		—		—		—		—		—		—		106	133	—	
Sum.............	72	74	160	220	36	61	78	122	126	153	312	402	111	118	130	141	470	558	50	63
Reduced ratio	1·79								1·60						1·52					

Duration in minutes	15. K.	15. S.	16. K.	16. S.	17. K.	17. S.	18. K.	18. S.	19. K.	19. S.	20. K.	20. S.	21. K.	21. S.	22. K.	22. S.	23. K.	23. S.	24. K.	24. S.
	60	63	38	45	150	160	66	69	31	38	54	59	93	97	18	22	33	36	91	102
	15	14	49	53	16	23	32	51	—		12	19	—		33	29	26	33	94	102
	41	43	27	32	27	31	—		—		44	45	—		—		—		—	
	—		—		24	27	—		—		—		—		—		—		—	
Sum............	116	120	114	130	217	241	98	120	31	38	110	123	93	97	51	51	59	69	185	204
Reduced ratio.....	1·43						1·52						1·41							

Duration in minutes..	25.		26.		27.		28.		29.		30.		31.		32.		33.		34.	
	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.
	39	47	54	46	81	90	84	81	—		12	13	61	67	—		106	114	151	143
	25	27	57	60	49	51	27	26	—		—		—		—		—		—	
	78	98	—		51	51	51	48	—		—		—		—		—		—	
Sum................	142	172	111	106	181	192	162	155	—		12	13	61	67	—		106	114	151	143
Reduced ratio	1·36										1·33									

Duration in minutes..	35.		36.		37.		38.		39.		40.		41.		42.		43.		44.		45.		46.		47.	
	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.
	23	34	97	95	132	130	—		—		—		167	156	—		—		79	77	—		—		56	53
	—		—		—		—		—		—		97	95	—		—		—		—		—		—	
Sum	23	34	97	95	132	130	—		—		—		264	251	—		—		79	77	—		—		56	53
Reduced ratio	1·34												1·24													

Duration in minutes..	48.		49.		50.		51.		52.		53.		54.		55.		56.		57.		58.		59.		60.	
	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.
Sum	—		—		—		62	69	134	133	—		—		—		—		—		—		—		—	
Reduced ratio..							1·34																			

Duration in minutes..	61.		62.		63.		64.		65.		66.		67.		68.		69.		70.		71.		72.		73.	
	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.	K.	S.
Sum	—		—		—		99	94	—		—		78	75	—		—		—		—		—		86	85
Reduced ratio							1·25																			

Table II will explain itself. In it we have embodied the various individual observations of Table I, with the following exceptions :—

On account of apparently unequal duration.		On account of the duration being under five minutes.
No. 3	....	No. 10
„ 9	....	„ 11
„ 15	....	„ 12
„ 17	....	„ 21
„ 18	....	„ 28
„ 33	....	„ 32
„ 56	....	„ 34
„ 64	....	„ 42
„ 65	....	„ 54
„ 66	....	„ 68
„ 71	....	„ 69
„ 76	....	„ 107
„ 84		
„ 88		
„ 95		
„ 96		

From Table II we may deduce the following conclusions:—

(1.) *In the very great majority of cases the angular value of the declination disturbance is greater for Stonyhurst than for Kew.*

(2.) *The ratio* $\frac{S}{K}$ *is certainly greater for disturbances of short than for those of long duration. Our observations are not, however, sufficiently extensive to enable us to represent this ratio graphically as a function of the duration.*

(3.) *As far as we can tell from a limited number of observations the value of the above ratio does not depend on the magnitude of the disturbance.*

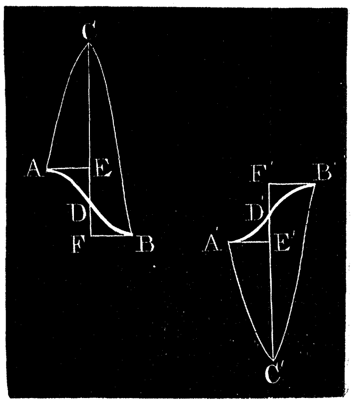
We trust to make on a future occasion a more complete comparison between the simultaneous magnetic fluctuations as derived from the curves of the two observatories.

Note.—It might be desirable to add a few words in fuller explanation of the method adopted.

This method is founded on the implied belief that disturbances are indications of the way in which the magnetic earth rights itself with regard to the forces acting upon it. Our experience is that such disturbances never occur singly, but very frequently as couplets or sets of couplets. There is no such thing as a magnetic tableland separated from another by a single slope. We have rather a rise and then a fall, or it may be a fall and then a rise, and in the end the state of things, after the disturbance has run its course, is not greatly different from that before it began. This duality, as well as the results of this paper, would lead us to imagine

that secondary currents must have an influence, perhaps a powerful one, in causing disturbances.

In order to fix the mind, let us here imagine that this secondary current influence (exhibited probably in the shape of an earth current) is opposed in direction to the true magnetic change. We should, therefore, expect something of the following nature.



ED or E′D′ = magnetic change, first movement.
DF or D′F′ = magnetic change, second movement.
DC or D′C′ $= \frac{\alpha k}{t}$.

In the first of these diagrams AB denotes a true magnetic descending change, while ACB is the observed disturbance couplet. In the second A′B′ denotes a true magnetic ascending change, while A′C′B′ is the observed disturbance couplet.

In our various measurements, therefore, it is assumed that we pass from a point of no disturbance, A or A′, to another, C or C′, in which there is a magnetic change and a superposed secondary current change, or from a point in which these two forces act to a final point, B or B′, of no disturbance. Now the *maximum* earth current force will depend upon the *maximum* rate of magnetic change. This maximum rate we cannot tell, but we may imagine it to be proportional to the mean rate of magnetic change, being possibly represented in an approximate manner by the expression—

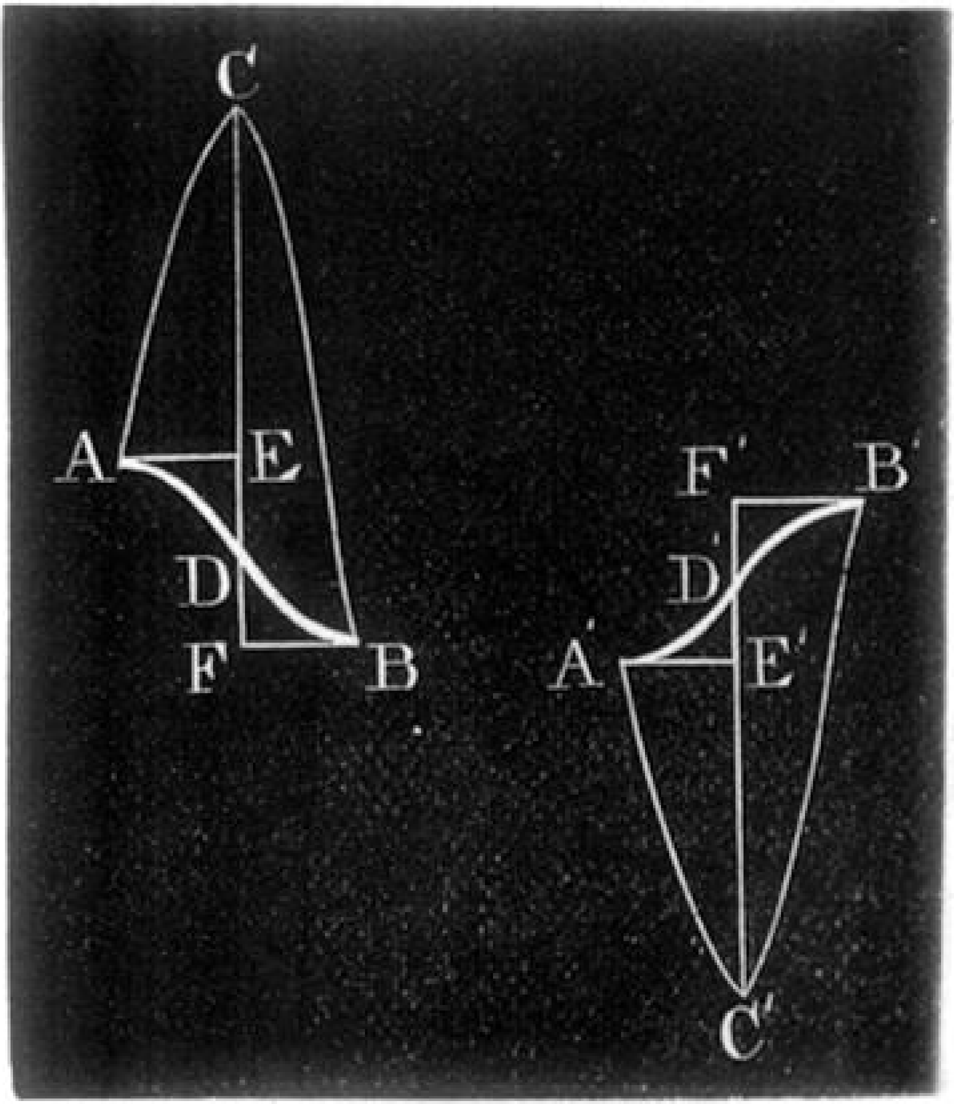
Max. current force = a constant × $\frac{\text{magnetic change}}{\text{duration}}$. In other words, our general functions of the text would be replaced by the expressions (taking both branches of the curve)—

$$K = k\left(1 \mp \frac{\alpha}{t}\right)$$

$$S = k\left(\beta \mp \frac{\gamma}{t}\right)$$

It would appear from this as well as from the diagrams that the first turn of a couplet should be less than the second.

The results in our paper cannot, therefore, be regarded as a final analysis, but merely as being of sufficient interest to demand a fuller inquiry.—November 4th, 1885.



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